CLAIMS

What is claimed is:

1. A method of separating signal components comprising:

performing a decomposition on a channel estimate matrix to generate a unitary orthogonal matrix and an upper triangular matrix;

multiplying received complex signals by a conjugate transpose of the unitary orthogonal matrix to generate a z-vector; and

estimating transmitted complex signal components of a multicarrier signal from the upper triangular matrix, the upper triangular matrix, and components of the z vector.

2. The method of claim 1 wherein estimating comprises:

estimating a second transmitted complex signal representing a second signal component of the multicarrier signal from the upper triangular matrix and a second component of the z-vector; and

estimating a first transmitted complex signal representing a first signal component of the multicarrier signal based on the estimated second transmitted complex signal, the upper triangular matrix, and a first component of the z vector.

3. The method of claim 2 further comprising:

estimating nearest neighbors of the estimated second transmitted complex signal;

re-estimating the first transmitting complex signal for each of the nearest neighbors of the second transmitted complex signal;

computing Euclidian distances between the first transmitted complex signal and the second transmitted complex signal, and between the re-estimated first transmitted complex signals and each neighbor of the second transmitted complex signal; and

selecting a pair of signal estimates associated with the lowest computed distance, the selected pair corresponding to final estimates of the first and second transmitted complex signals.

4. The method of claim 3 wherein the transmitted complex signal components were transmitted separately over more than one non-orthogonal spatial channel using more than one corresponding transmit antennas, and

wherein the final estimates of the first and second transmitted complex signals are substantially decoupled from crosstalk between the non-orthogonal spatial channels.

5. The method of claim 1 wherein the z-vector is equal to a noise factor plus the upper triangular matrix multiplied by an x-vector,

wherein components of the x-vector represent individual complex signal components transmitted over corresponding individual spatial channels, and

wherein the conjugate transpose of the unitary orthogonal matrix is a hermitian of the unitary orthogonal matrix comprising a hermitian matrix.

6. The method of claim 2 wherein estimating the second transmitted complex signal comprises generating a substantially interference-free estimate of the second transmitted complex signal, the interference-free estimate being substantially free from contributions of the first transmitted complex signal.

7. The method of claim 4 wherein the channel estimate matrix comprises a matrix of channel estimates for the plurality of spatial channels between a receiving station and a transmitting station.

8. The method of claim 7 wherein the plurality of spatial channels comprise spatial channels defined by communication paths between a pair of transmit antennas and a pair receive antennas, and

wherein the channel estimate matrix comprises a 2x2 matrix.

9. The method of claim 7 wherein the plurality of spatial channels comprise spatial channels defined by:

either two transmit antennas or a single transmit antenna coupled to the transmitting station employing beamforming techniques to define two transmit spatial channels;

either two receive antennas or a single receive antenna coupled to the receiving station employing beamforming techniques to define two receive spatial channels, and

wherein the channel estimate matrix comprises a 2x2 matrix of channel estimates for the spatial channels.

10. The method of claim 2 wherein the multicarrier signal comprises two orthogonal frequency division multiplexed signal components of a single orthogonal frequency division multiplexed symbol transmitted substantially simultaneously over the plurality of spatial channels,

wherein each orthogonal frequency division multiplexed signal component comprises a plurality of symbol-modulated subcarriers transmitted on orthogonal symbol-modulated subcarriers, and

wherein the spatial channels are non-orthogonal channels, each employing symbol-modulated subcarriers of the same frequencies.

11. The method of claim 10 wherein the performing, the multiplying, the estimating a second transmitted complex signal, and the estimating a first transmitted complex symbol are performed for a first subcarrier of the plurality of symbol-modulated subcarriers, and

wherein the method further comprises repeating the performing, the multiplying, the estimating a second transmitted complex signal, and the estimating a first transmitted complex symbol for other subcarriers of the plurality, and

wherein performing the decomposition comprises performing a decomposition of a channel matrix of channel estimates for each of the subcarriers of the plurality of subcarriers.

12. The method of claim 10 wherein each of the two orthogonal frequency division multiplexed signal components is to have been modulated with separate data symbols of a single transmitted orthogonal frequency division multiplexed symbol.

13. The method of claim 12 further comprising:

for each subcarrier, performing a quadrature amplitude modulation demapping on the first transmitted complex signal and the second transmitted complex signal to generate corresponding first and second bits for each subcarrier; and

deinterleaving and decoding the first and second bits from the subcarriers to generate a combined bit stream representing the single transmitted orthogonal frequency division multiplexed symbol.

14. A spatial channel decoupler comprising:

a decomposer to perform a decomposition on a channel estimate matrix to generate a unitary orthogonal matrix and an upper triangular matrix;

a multiplier to multiply received complex signals by a conjugate transpose of the unitary orthogonal matrix to generate a z-vector; and

a transmitted signal estimator to estimate transmitted complex signal components of a multicarrier signal from the upper triangular matrix, the upper triangular matrix, and components of the z vector.

15. The decoupler of claim 14 wherein the transmitted signal estimator estimates a second transmitted complex signal representing a second signal component of the multicarrier signal from the upper triangular matrix and a second component of the z-vector, and

wherein the transmitted signal estimator further estimates a first transmitted complex signal representing a first signal component of the multicarrier signal based on the estimated second transmitted complex signal, the upper triangular matrix, and a first component of the z vector.

16. The decoupler of claim 15 further comprising:

a neighbor calculator to estimate nearest neighbors of the second transmitted complex signal;

a distance calculator to compute Euclidian distances; and

a selector,

wherein the transmitted signal estimator re-estimates the first transmitted complex signal for each of the nearest neighbors of the second transmitted complex signal,

wherein the distance calculator computes Euclidian distances between the first transmitted complex signal and the second transmitted complex signal, and between the re-estimated first transmitted complex signals and each neighbor of the second transmitted complex signal, and

wherein the selector selects a pair of signal estimates associated with the lowest computed distance, the selected pair corresponding to a final estimate of the first and second transmitted complex signals.

17. The decoupler of claim 16 wherein the transmitted complex signal components were transmitted separately over more than one non-orthogonal spatial channel using more than one corresponding transmit antennas, and

wherein the final estimate of the first and second transmitted complex signals is substantially decoupled from crosstalk between non-orthogonal spatial channels.

18. The decoupler of claim 14 wherein the z-vector is equal to a noise factor plus the upper triangular matrix multiplied by an x-vector,

wherein components of the x-vector represent individual complex signal components transmitted over corresponding individual spatial channels, and

wherein the conjugate transpose of the unitary orthogonal matrix is a hermitian of the unitary orthogonal matrix comprising a hermitian matrix.

19. The decoupler of claim 15 wherein the transmitted signal estimator is to generate an interference-free estimate of the second transmitted complex signal,

the interference-free estimate being substantially free from contributions of the first transmitted complex signal.

20. The decoupler of claim 17 wherein the channel estimate matrix comprises a matrix of channel estimates for the plurality of spatial channels between a receiving station and a transmitting station, and

wherein the receiving station comprises a spatial channel decoupler for each subcarrier frequency of an orthogonal frequency division multiplexed channel.

21. The decoupler of claim 20 wherein the plurality of spatial channels comprise four spatial channels defined by communication paths between a pair of transmit antennas coupled with the transmitting station and a pair receive antennas coupled with the receiving station, and

wherein the channel estimate matrix comprises a 2x2 matrix.

22. A receiver comprising:

one or more receive antennas to receive a multicarrier signal having components separately transmitted through at least two spatial channels; and

a spatial channel decoupler to separate the separately transmitted signal components of the received multicarrier signal,

wherein the spatial channel decoupler comprises:

a decomposer to perform a decomposition on a channel estimate matrix to generate a unitary orthogonal matrix and an upper triangular matrix;

a multiplier to multiply received complex signals corresponding with the received multicarrier signals by a conjugate transpose of the unitary orthogonal matrix to generate a z-vector; and

a transmitted signal estimator to estimate transmitted complex signal components of the multicarrier signal from the upper triangular matrix, the upper triangular matrix, and components of the z vector.

23. The receiver of claim 22 wherein the transmitted signal estimator estimates a second transmitted complex signal representing a second signal component of the multicarrier signal from the upper triangular matrix and a second component of the z-vector, and

wherein the transmitted signal estimator further estimates a first transmitted complex signal representing a first signal component of the multicarrier signal based on the estimated transmitted complex signal, the upper triangular matrix, and a first component of the z vector.

24. The receiver of claim 23 wherein the spatial channel decoupler further comprises:

a neighbor calculator to estimate nearest neighbors of the second transmitted complex signal;

a distance calculator to compute Euclidian distances; and

a selector,

wherein the transmitted signal estimator is to re-estimate the first transmitted complex signal for each of the nearest neighbors of the second transmitted complex signal,

wherein the distance calculator computes Euclidian distances between the first transmitted complex signal and the second transmitted complex signal, and between the re-estimated first transmitted complex signals and each neighbor of the second transmitted complex signal, and

wherein the selector selects a pair of signal estimates associated with the lowest computed distance, the selected pair corresponding to a final estimate of the first and second transmitted complex signals.

25. The receiver of claim 22 wherein the received multicarrier signal comprises two orthogonal frequency division multiplexed signal components of a single orthogonal frequency division multiplexed symbol transmitted substantially simultaneously over the plurality of spatial channels,

wherein each orthogonal frequency division multiplexed signal component comprises a plurality of symbol-modulated subcarriers transmitted on orthogonal symbol-modulated subcarriers,

wherein the spatial channels are non-orthogonal channels, each employing symbol-modulated subcarriers of the same frequencies, and

wherein the receiver further comprises:

a spatial channel decoupler associated with each of the subcarriers to generate transmitted signal estimates for the associated subcarrier.

26. The receiver of claim 25 wherein each of the two orthogonal frequency division multiplexed signal components is to have been modulated with separate data symbols of a single transmitted orthogonal frequency division multiplexed symbol, and

wherein the receiver further comprises:

a demapper to perform a quadrature amplitude modulation demapping on the first transmitted complex signal and the second transmitted complex signal to generate corresponding first and second bits for each subcarrier; and

deinterleaver and decoder circuitry to deinterleave and decode the first and second bits to generate a combined bit stream representing the single transmitted orthogonal frequency division multiplexed symbol.

27. A machine-readable medium that provides instructions, which when executed by one or more processors, cause the processors to perform operations comprising:

performing a decomposition on a channel estimate matrix to generate a unitary orthogonal matrix and an upper triangular matrix;

multiplying received complex signals by a conjugate transpose of the unitary orthogonal matrix to generate a z-vector; and

estimating transmitted complex signal components of the multicarrier signal from the upper triangular matrix, the upper triangular matrix, and components of the z vector.

28. The machine-readable medium of claim 27 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations further comprising:

estimating a second transmitted complex signal representing a second signal component of the multicarrier signal from the upper triangular matrix and a second component of the z-vector; and

estimating a first transmitted complex signal representing a first signal component of the multicarrier signal based on the estimated second transmitted complex signal, the upper triangular matrix, and a first component of the z vector.

29. The machine-readable medium of claim 28 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations, comprising:

estimating nearest neighbors of the second transmitted complex signal;

re-estimating the first transmitting complex signal for each of the nearest neighbors of the second transmitted complex signal;

computing Euclidian distances between the first transmitted complex signal and the second transmitted complex signal, and between the re-estimated first transmitted complex signals and each neighbor of the second transmitted complex signal; and

selecting a pair of signal estimates associated with the lowest computed distance, the selected pair corresponding to a final estimate of the first and second transmitted complex signals,

the final estimate of the first and second transmitted complex signals being substantially decoupled from crosstalk between non-orthogonal spatial channels comprising orthogonal symbol modulated orthogonal subcarriers.

30. The machine-readable medium of claim 27 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations, wherein the z-vector is equal to a noise factor plus the upper triangular matrix multiplied by an x-vector, and

wherein components of the x-vector represent individual complex signal components transmitted over corresponding individual spatial channels.

31. The machine-readable medium of claim 27 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations, wherein the conjugate transpose of the unitary orthogonal matrix is a hermitian of the unitary orthogonal matrix comprising a hermitian matrix.

32. The machine-readable medium of claim 28 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations, wherein estimating the second transmitted complex signal comprises generating an interference-free estimate of the second transmitted complex signal, the interference-free estimate being substantially free from contributions of the first transmitted complex signal.

33. The machine-readable medium of claim 27 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations, wherein the channel estimate matrix comprises a matrix of channel estimates for the plurality of spatial channels between a receiving station and a transmitting station.